United States Patent [19]

Kondó et al.

[11] **3,983,367**

[45] **Sept. 28, 1976**

[54] **SHEET COUNTING MACHINE**

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[73] Assignee: **Glory Kogyo Kabushiki Kaisha,** Japan

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[52] **U.S. Cl.** ..... **235/92 SB;** 235/92 CT; 235/92 CA; 235/92 R

[51] **Int. Cl.²** **H03K 21/36**

[58] **Field of Search** ..... 235/92 SB, 92 CT, 92 CA, 235/92 PE, 92 MS, 92, 98 R

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Assistant Examiner—John P. Vandenburg
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A sheet counting machine has a sheet counting mechanism which is controlled through a coincidence detecting circuit operating to compare a number of sheets counted with a predetermined number of sheets. The coincidence detecting circuit is provided with a mode changing switch and an inverter connected thereto in the output path to relatively reverse a logical level of an output of the coincidence detecting circuit stop mode. The logical level thus relatively reversed is utilized for controlling the operation of the mechanism through switching elements and relay elements.

1 Claim, 9 Drawing Figures

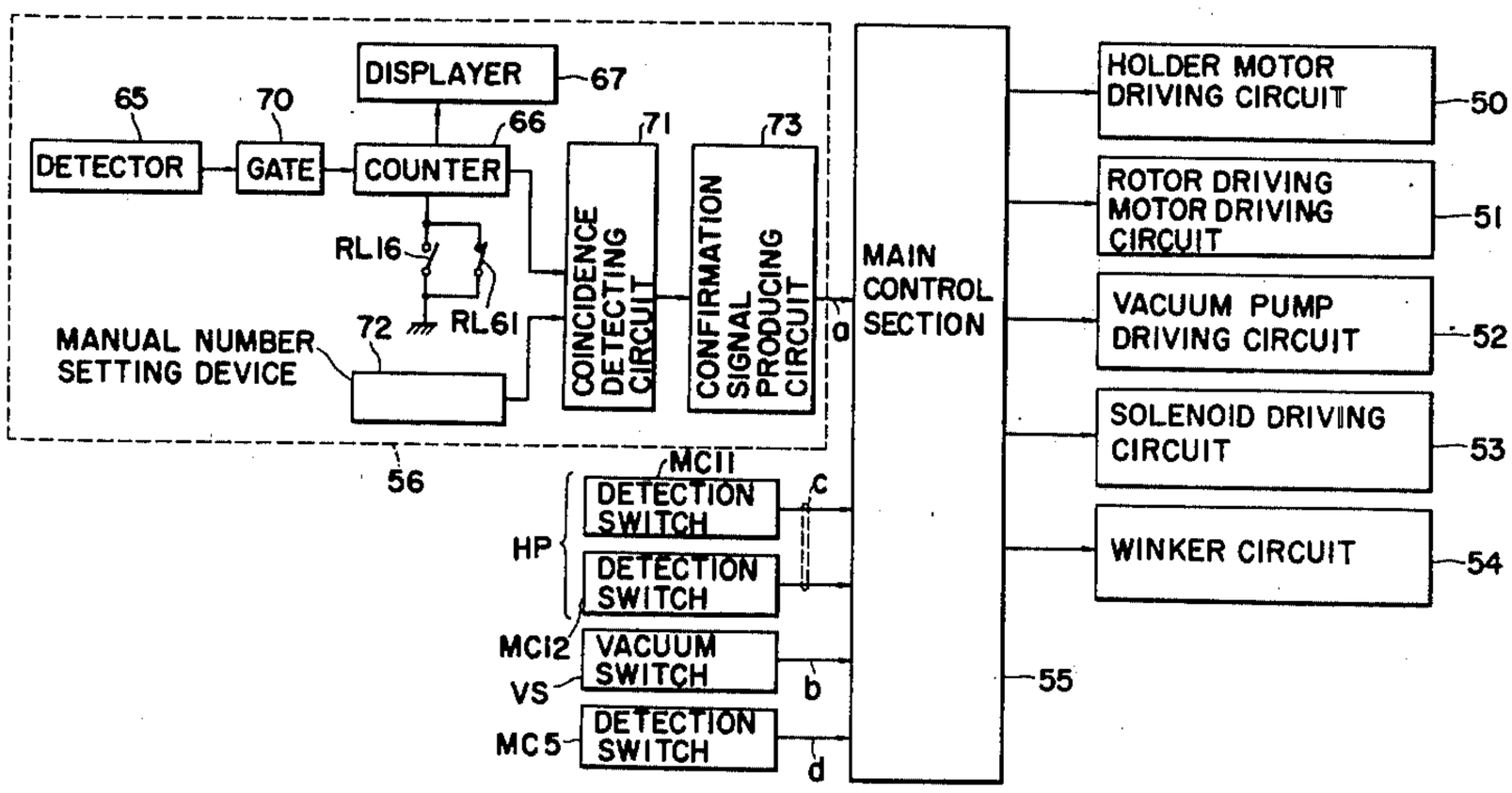


FIG. 1

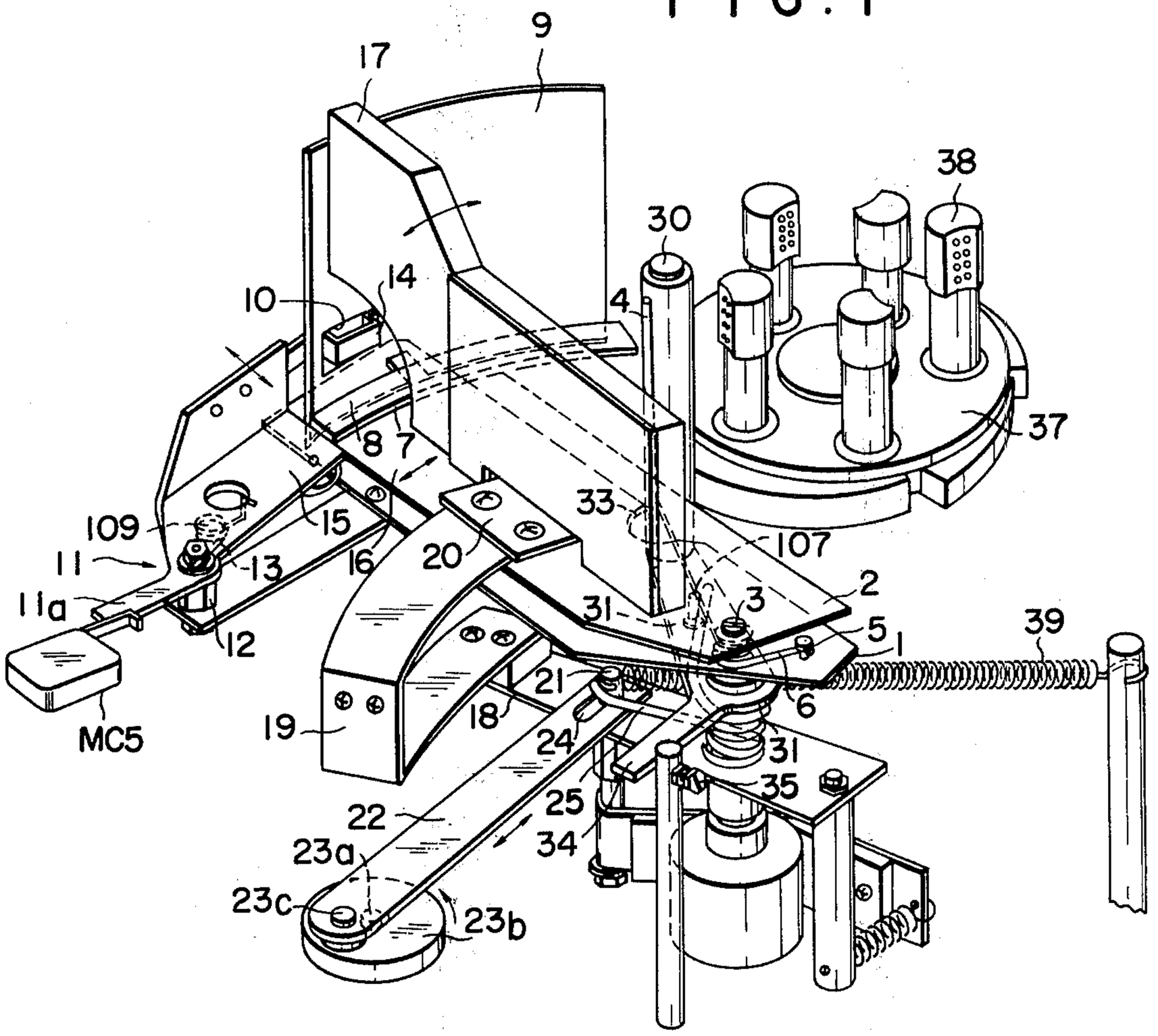

9
17
38
30
14
10
4
37
8
7
33
109
15
107
11
13
16
20
2
11a
31
3
5
39
12
1
21
6
MC5
19
18
24
31
35
25
22
34
23a
23c
23b

FIG. 2

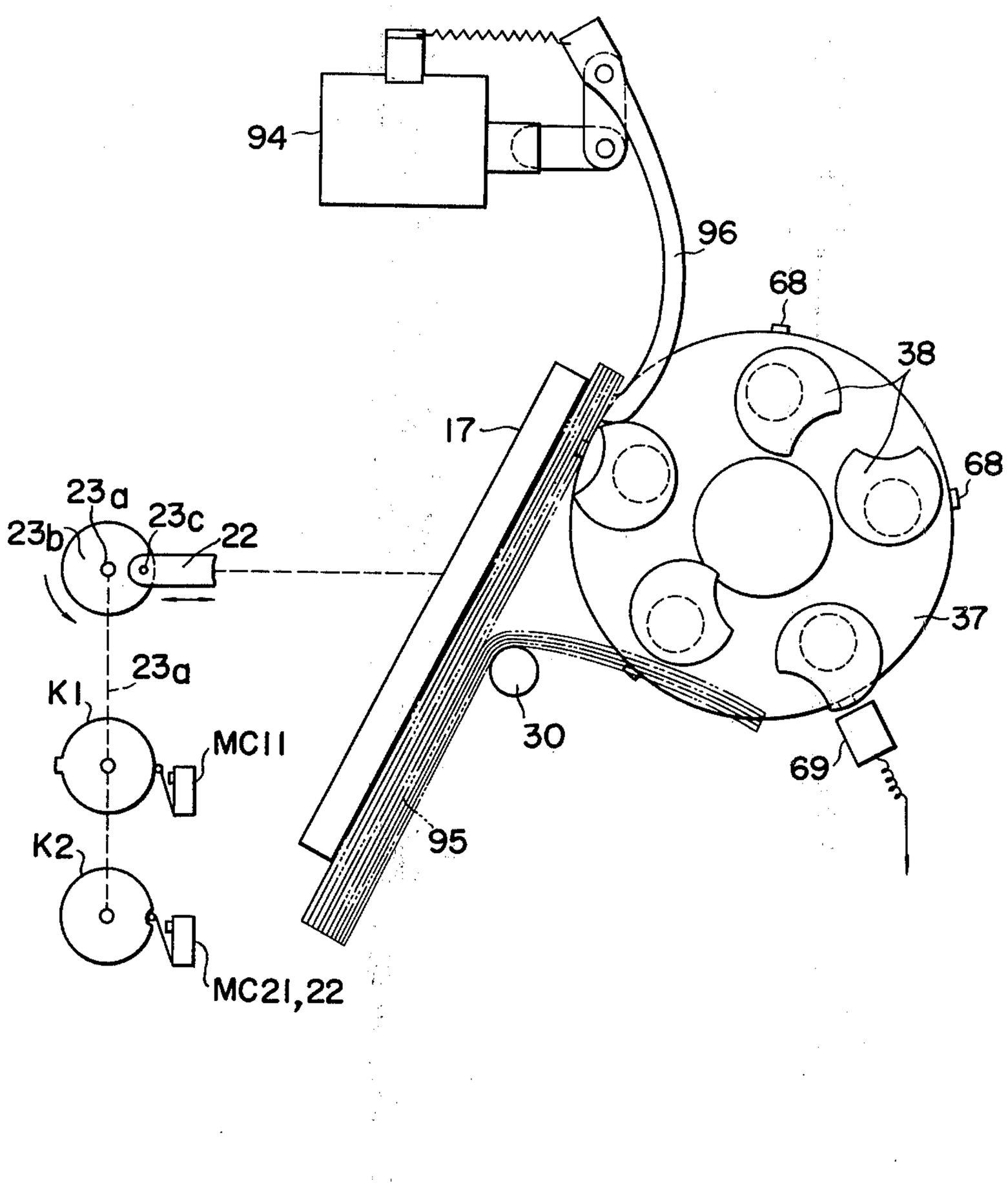


FIG. 3

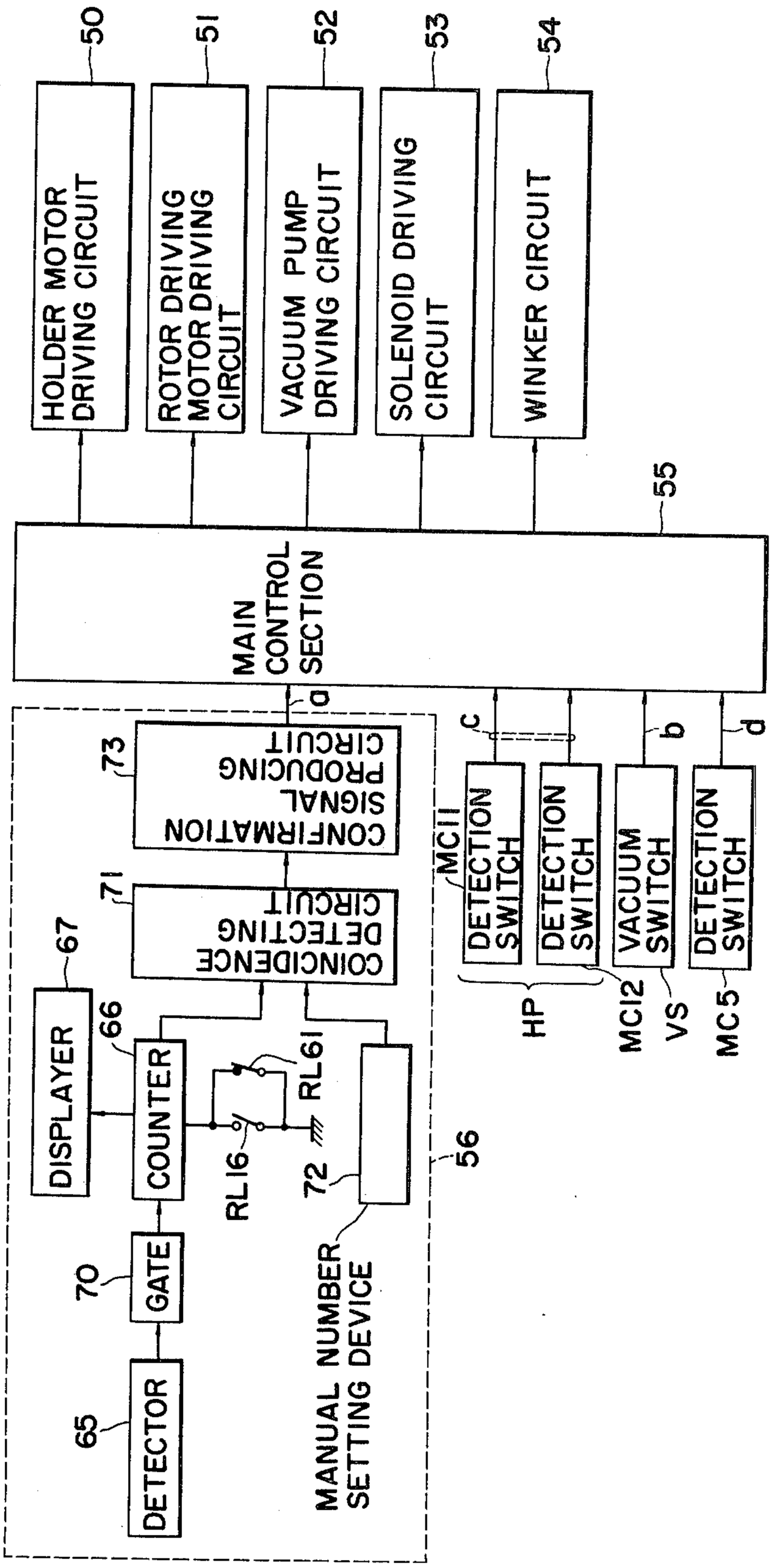

50
51
52
53
54
HOLDER MOTOR DRIVING CIRCUIT
ROTOR DRIVING MOTOR DRIVING CIRCUIT
VACUUM PUMP DRIVING CIRCUIT
SOLENOID DRIVING CIRCUIT
WINKER CIRCUIT
55
MAIN CONTROL SECTION
a
73
CONFIRMATION SIGNAL PRODUCING CIRCUIT
71
COINCIDENCE DETECTING CIRCUIT
67
DISPLAYER
66
COUNTER
RL61
RL16
72
56
70
GATE
65
DETECTOR
MANUAL NUMBER SETTING DEVICE
MCII
DETECTION SWITCH
DETECTION SWITCH
VACUUM SWITCH
DETECTION SWITCH
c
b
d
HP
MCI2
VS
MC5

FIG. 4

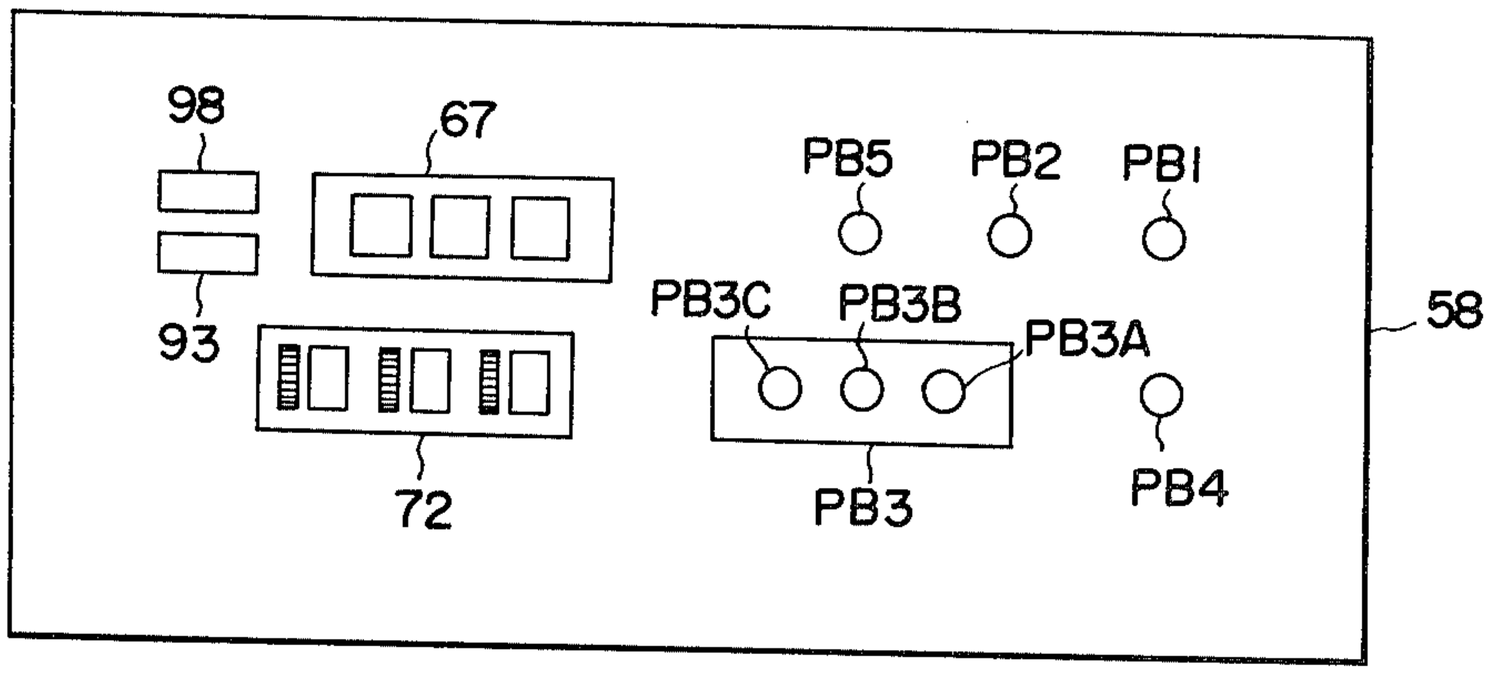


FIG. 6

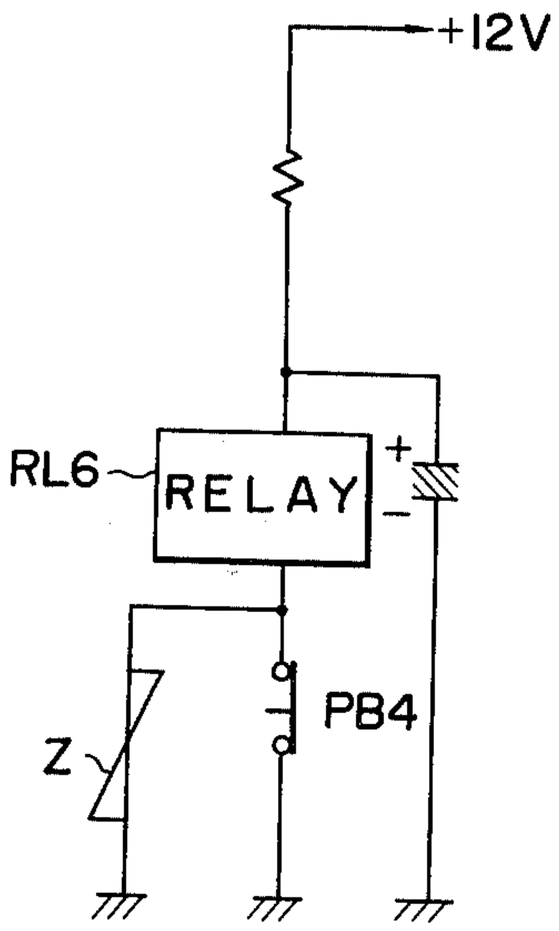


FIG. 8

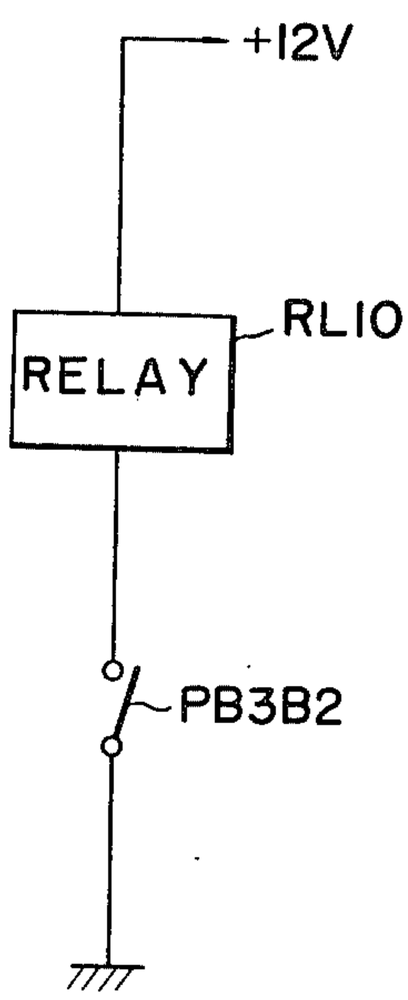
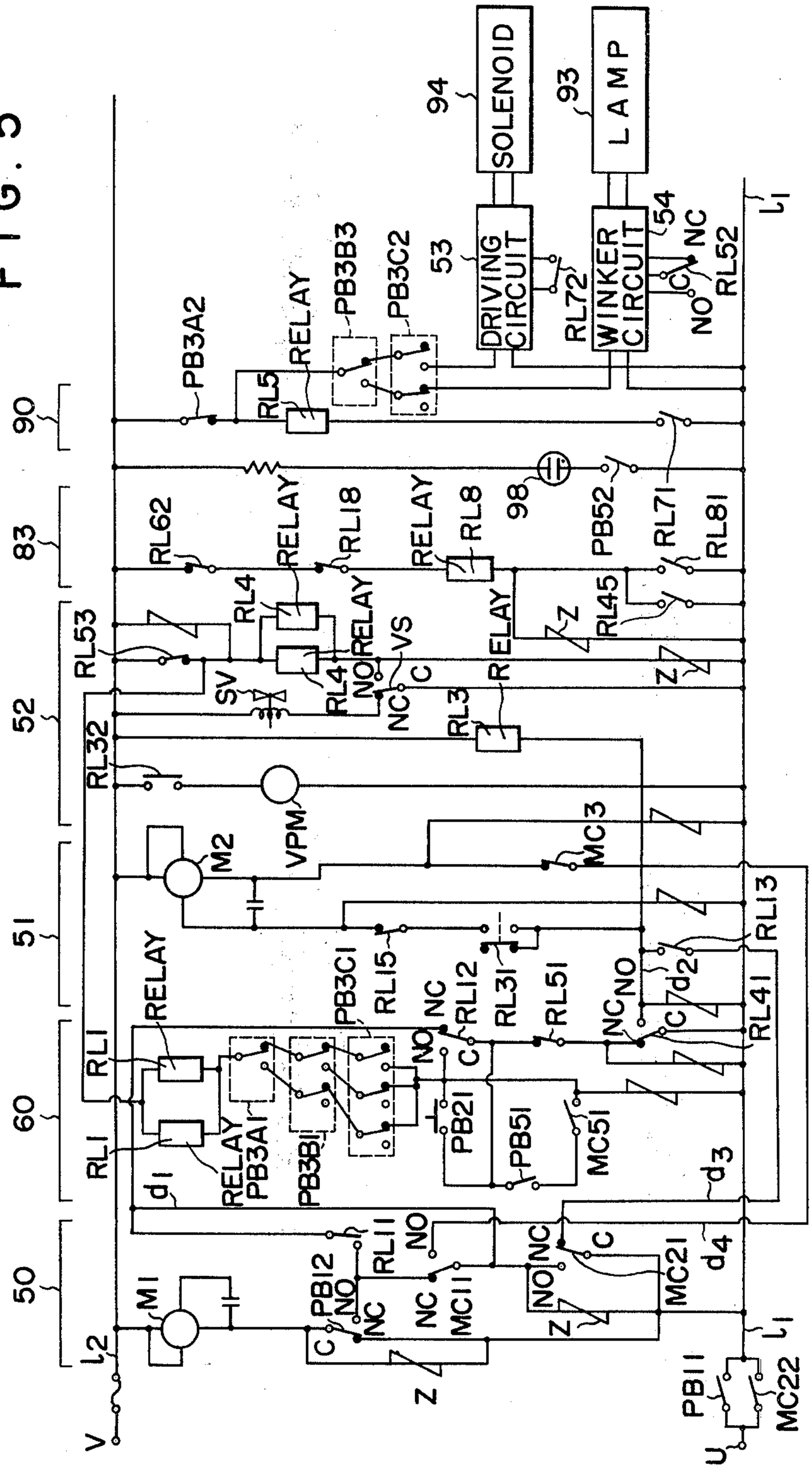


FIG. 5


94
SOLENOID
93
LAMP
PB3A2
RELAY
RL5
PB3B3
PB3C2
53
DRIVING CIRCUIT
RL72
WINKER CIRCUIT
54
NC
NO
C
RL52
L1
90
83
52
51
60
50
RL62
RELAY
RL18
RELAY
RL8
98
PB52
RL71
RL81
RL53
RL4
RELAY
RL4
NO
NC
VS
C
RELAY
RL3
RL45
Z
SV
RL32
RL3
M2
VPM
MC3
PB3C1
RL15
RL3I
RL5I
RL41
RL13
RLI
RELAY
RLI
RELAY
PB3AI
PB3BI
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NC
C
RLI2
PB2I
PB5I
MC5I
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d2
d3
d4
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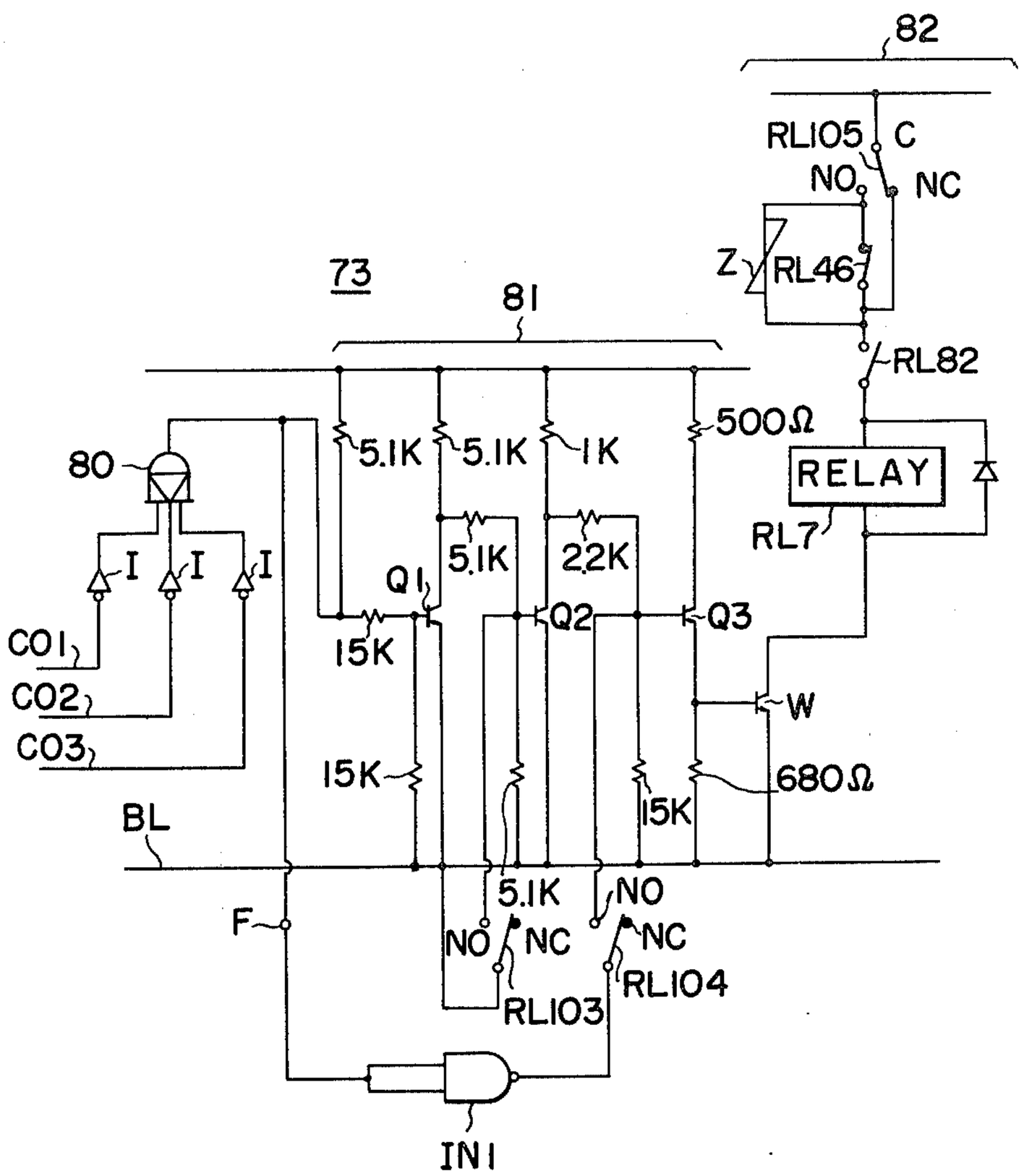
PBI2
MI
MCII
MC2I
PBII
MC22
L2
V
U
Z

FIG. 7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RL105
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NC
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RL46
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RL82
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5.1K
2.2K
Q1
Q2
Q3
I
I
I
15K
W
CO1
CO2
CO3
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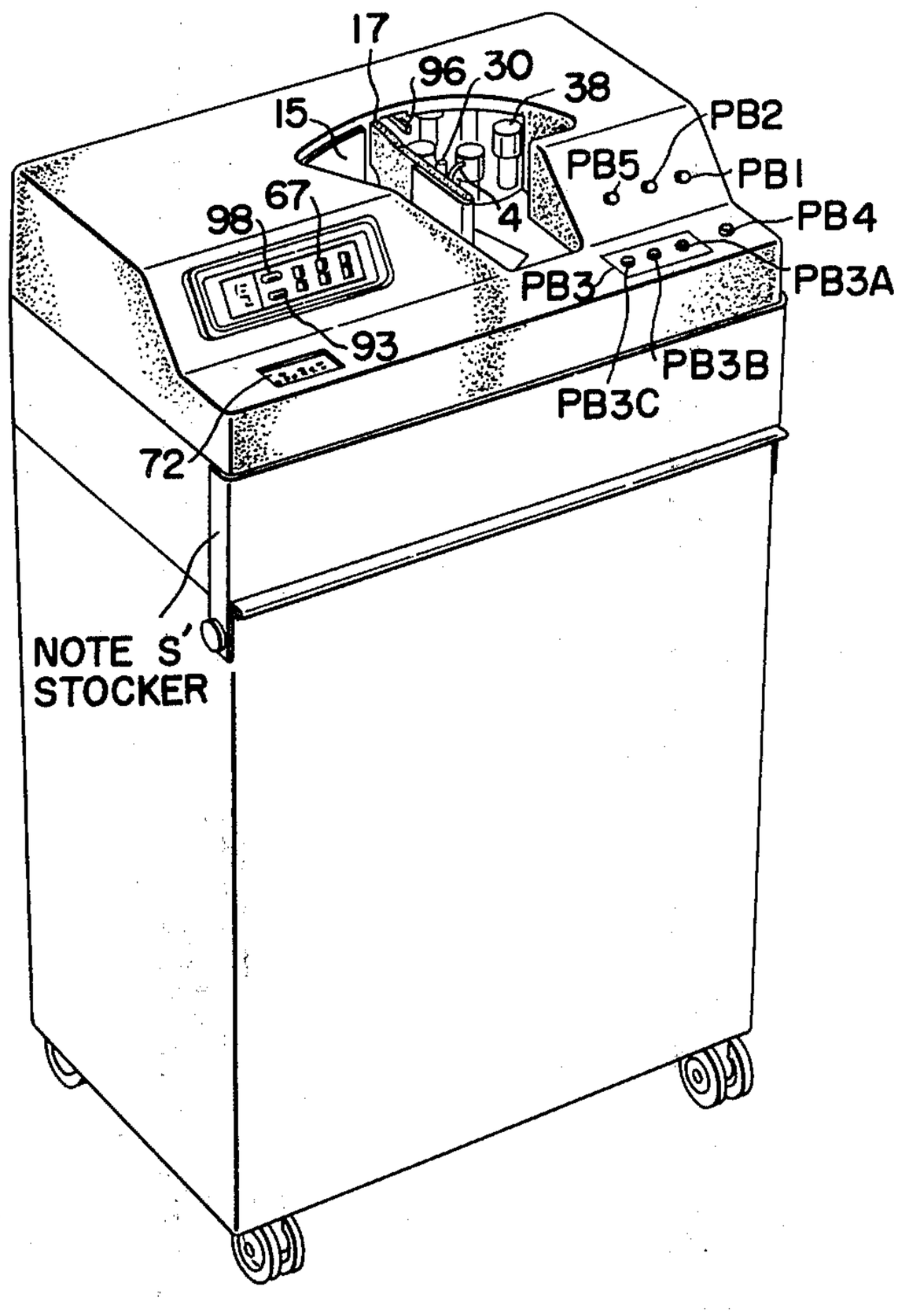
15K
BL
5.1K
NO
F
NO
NC
NC
RL104
RL103
IN1

FIG. 9


17
96
30
38
15
PB2
PB5
PB1
67
98
4
PB4
PB3
PB3A
93
PB3B
PB3C
72
NOTE S'
STOCKER

SHEET COUNTING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to sheet counting machines operating to count a number of sheets such as bank notes and cards.

There are two types of sheet counting machines known in the art. One is operated in a sheet counting mode in which a number of sheets to be counted in one sheet counting operation is predetermined and the sheet counting operation is suspended when the number of sheets counted reaches the predetermined number of sheets (hereinafter referred to as "an automatic stop mode"). The other is operated in a sheet counting mode in which all of the sheets inserted are counted, and upon completion of the sheet counting operation an alarm signal is generated if the number of sheets counted is more than or less than a predetermined reference number of sheets, for instance, 100 sheets (hereinafter referred to as "an alarm mode").

The former machine is used for dividing a stack or bundle of many sheets into a plurality of stacks each consisting of a predetermined number of sheets (for instance 100 sheets). The latter machine is used for confirming the number os sheets which are bundled so that the bundle includes a predetermined number of sheets, for instance 100 sheets, (hereinafter referred as "an official number of sheets"). Thus, the conventional sheet counting machine is operated only in the automatic stop mode or only in the alarm mode.

Accordingly, there is a strong demand for the provision of a sheet counting machine which can count a number of sheets in the alarm mode and also in the automatic stop mode, in order to improve efficiency in counting a number of sheets.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to provide a novel sheet counting machine which can be operated in both the automatic stop mode and the alarm mode described above.

Another object of the invention is to provide a sheet counting machine having a simple construction.

A further object of the invention is to provide a sheet counting machine which positively carries out a sheet counting operation.

The foregoing objects and other objects as well as the characteristic features of this invention will become more apparent from the following detailed description and the appended claim when read in conjunction with accompanying drawings, in which like parts are designated by like reference numerals or characters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is a perspective view illustrating a sheet counting mechanism of a sheet counting machine to which this invention can be applied;

FIG. **2** is an explanatory diagram used for a description of a sheet counting operation carried out by the sheet counting machine;

FIG. **3** is a block diagram of an example of the sheet counting machine according to the invention;

FIG. **4** is a schematic diagram showing a control board of the sheet counting machine;

FIGS. **5** through **8** are circuit diagrams for the block diagram of FIG. **3**; and

FIG. **9** is a perspective view showing the appearance of the sheet counting machine according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

As conducive to a full understanding of this invention, the construction of a sheet counting machine to which the invention can be applied will be described with reference to FIG. **1**.

The sheet counting machine has a machine frame **1**, a sheet laying plate **2** having an arc-shaped end which is rotatably mounted on a shaft **3**, a pin **5** provided on the frame **1**, and a sheet holding pin **4** embedded in the sheet laying plate **2**. These pins **4** and **5** are connected with a spring **6** wound around the shaft **3** so that the plate **2** is turned counterclockwise as viewed from above.

The frame **1** is provided with a sheet sliding plate **8** in such a manner that there is a slight gap **7** between the plate **8** and the arc-shaped end edge of the plate **2**, and the upper surface of the plate **8** is flush with that of the plate **2**. The outer edge of the sheet sliding plate **8** is fixedly connected to a sheet stop **9** which forms a vertical wall. The left portion of the stop **9** has a slot **10**. As is apparent from the above description and FIG. **1**, the edge of the sheet sliding plate **8** is arc-shaped, and the wall of the stop **9** is cylindrical.

On the left side of the sheet sliding plate **8**, there is a stop **11** rotatably mounted on a shaft **12**. This stop is turned clockwise by a spring **13** so as to detain the rotation of the sheet sliding plate **8**. Reference numeral **109** designates a part which engages an end of the spring **13**. On the upper portion of the stop a release lever **14** is fixedly provided. The end portion of the release lever **14** is bent, and this bent portion extends inward through the slot **10** of the sheet stop **9** so that the right end portion **15** of the stop **11** engages with the left upper end portion **16** of the sheet laying plate **2** so as to detain the counterclockwise turning of the sheet laying plate **2** unless the release lever **14** is pressed outward by sheets.

The machine further comprises a sheet clamping holder **17** under which there is a sheet clamping holder operating member **18** rotatably mounted on the shaft **3**. To one end portion of the member **18** one end portion (the lower end portion) of a U-shaped arm **19** is fixedly connected; while the other and portion **20** (the upper end portion) of the arm **19** is fixedly connected to the sheet clamping holder **17**. A pin **21** is embedded in the holder operating member **18**, and is coupled by a lever **22** having a slot **24** therein to a rotary disk **23***b* mounted on the rotary shaft **23***a* of an electric motor M_1 (not shown) through an eccentric shaft **23***c* provided on the rotary disk **23***b*. The lever **22** is coupled to the pin **21** through the slot **24**. The pin **21** is pulled by a spring **25** toward the outer end of the slot **24**. Thus, the lever **22** carries out a crank operation, that is, the lever **22** turns the member **18** and accordingly the holder **17** clockwise or counterclockwise according to rotation of the rotary disk **23***b*.

On the shaft **3** an arm member **31** is rotatably mounted which has a holder detaining pin **30** embedded in one end portion thereof. The spring **25** imparts a torque to the arm member **31** so that the arm member **31** is turned counterclockwise as viewed from above. Reference numeral **107** designates a part to which engages one end of the spring **25**. The holder detaining rod **30** is so arranged that it protrudes through a recess

33 provided in the frame 1 so as to regulate the clockwise turning of the holder 17. The arm member 31 has a protruding portion 34 on the other end portion thereof. This protruding portion 34 engages with an adjusting screw 35 so as to regulate the counterclockwise turning of the arm member 31.

Thus, the spring 25 imparts a force to the holder operating member 18 and the arm member 31 so that these elements 18 and 31 approach each other.

Reference numeral 39 designates a spring which operates to turn the holder operating member 18 together with the arm member 31 clockwise.

The stop 11 has a lever 11*a* at its rear end portion with which insertion detecting switch M_5 is engaged.

Reference numeral 38 designates suction heads provided on a rotor 37 of the sheet counting mechanism. When the rotor 37 is revolved by a motor M_2 (not shown), these suction heads 38 rotate at a speed corresponding to the revolution of the rotor 37. The sheet counting mechanism thus organized is subjected to drive control by a drive control circuit as follows.

If a stack of sheets is laid on the sheet laying plate 2 in such a manner that the sheets stand against the holder 17, and is then moved toward the sheet stop 9, the stack of sheets will abut the stop thereby pressing the release lever 14 outward. By this operation, the stop 11 is turned around the shaft 12 counterclockwise, and the right lower corner 15 of the stop 11 is disengaged from the sheet laying plate 2. Accordingly, the sheet laying plate 2 is turned counterclockwise by the spring 6, as a result of which the stack of sheets is sandwiched between the holder 17 and the sheet holding pin 4 embedded in the sheet laying plate 2.

In the case of the automatic stop mode, when the stop 11 is turned counterclockwise, the switch MC_5 is turned on by the lever 11*a* and the motor M_1 is operated. By the operation of the motor M_1, the lever coupled to the motor M_1 pushes the holder operating member 18, and accordingly the arm member 19 connected to the end portion of the holder operating member 18 turns the holder 17 clockwise. By this movement of the holder 17 the stack of sheets abut against the holder detaining pin 30, and therefore a further movement of the holder 17 is stopped. Under this condition, the end portion of the top sheet of the sheet stack comes to abut against a suction head 38 on the rotor 37. On the other hand, a vacuum pump VPM (now shown) is operated by the operation of the switch MC_5. When a vacuum created by the vacuum pump VPM reaches a predetermined value, a vacuum switch is actuated so that the suction heads 38 and the rotor 37 are rotated. As a result, the sheets in a stack are bent back around pin 30 one by one by the suction heads 38 to count the number of sheets as is shown in FIG. 2.

In order to clamp the stack of sheets with the holder 17 and the pin 30, the motor M_1 is rotated in the same direction again to produce the crank operation of the lever 22 and thereby to turn the holder 17 counterclockwise.

The sheet counting machine according to this invention employs a drive control circuit for the above-described sheet counting mechanism as shown in FIG. 3.

The drive control circuit has a main control section 55 which delivers drive condition signals to a holder motor driving circuit 50, a rotor driving motor driving circuit 51, a vacuum pump driving circuit 52, a sheet separating solenoid driving circuit 53, and a winker circuit 54. The main control section 55 receives, as its input condition signals, a count confirmation signal *a* from a count confirmation circuit 56, a detection signal *b* from the vacuum switch VS, a detection signal *c* from a holder position detector HP, and a detection signal *d* from the detector MC_5 operating to detect the insertion of a stack of sheets.

The main control section 55, as is shown in FIG. 4, comprises a mode changing switch PB_3, a manual start switch PB_2, an automatic start switch PB_5, a reset switch PB_4, and a power switch PB_1, the key levers of which are arranged on a control board 58.

A first normally-open contact means PB_{11} of the power switch PB_1, as is shown in FIG. 5, is connected between one power terminal U and a power line 1_1. The other power terminal V is connected directly to a power line l_1. The other power terminal V is connected directly to a power line l_2.

The mode changing switch PB_3 is composed by three stay-down key switches operatively associated with one another, that is, the switch PB_3 is composed by an automatic stop mode selecting switch PB_{3A}, an alarm mode selecting switch PB_{3B}, and a count mode selecting switch PB_{3C}. The automatic start switch PB_5 is also a stay-down key switch.

The term "count mode" herein used means a sheet counting operation in which all of the sheets inserted in the sheet counting mechanism are completely counted, and upon completion of the counting operation the operation of the sheet counting mechanism is suspended.

In the example described above, as is shown in FIG. 5 one contact of a selecting switch PB_{3A1}, two contacts of a selecting switch PB_{3B1} and three contacts of a selecting switch PB_{3C1} are cascade-connected in the order stated. This cascade connection circuit forms a conduction path only when any one of the switches PB_{3B1}, PB_{3B1} and PB_{3C1} is operated. The cascade connection circuit is a part of a start circuit 60 of the main control section 58.

The start circuit 60 has a relay RL_1. When a manual start switch PB_{21} is depressed upon operation of manual start switch PB_2, the relay RL_1 is energized by forming a loop: the power line l_2 — a normally closed contact means of a count confirmation relay RL_5 described later — the relay RL_1 — the selection switches PB_{3A1}, PB_{3B1}, PB_{3C1} — a contact means PB_{21} of the manual start switch PB_2 — a normally closed contact means RL_{51} of the count confirmation relay RL_5 — a normally, closed contact means RL_{41} of the count operation relay RL_4 — the power line l_1. On the other hand, when a stack of sheets is inserted into the holder 17 with the automatic start switch PB_{51} turned on, the relay RL_1 is energized through a loop: the power line l_2 — the normally closed contact means of the count confirmation relay RL_5 — the relay RL_1 — the selection switches PB_{3A1}, PB_{3B1}, PB_{3C1} — a sheet insertion detecting switch MC_{51} — a contact means PB_{51} of the automatic start switch PB_5 — the power line l_1. This energization is self-maintained because the armature of a contact means RL_{12} of the relay RL_1 is thrown to the normally open contact NO thereof by the energization of the relay RL_1.

An output line d_1 is connected between the normally closed contact NC of the contact means RL_{12} of the relay RL_1 and the holder motor driving circuit 50. Furthermore, an output line d_2 is extended from the normally open contact NO of a contact means RL_{41} of a

relay RL_4 to the vacuum pump driving circuit **52** and the rotor driving motor driving circuit **51.**

The holder motor driving circuit **50** has a holder open position detecting switch MC_{11} the armature of which is thrown to the normally open contact from the normally closed contact when the holder **17** reaches the open position, and a holder closure position detecting switch MC_{21} the armature of which is thrown to the normally closed contact from the normally open contact when the holder **17** reaches the closure position.

The holder motor M_1 is energized through a loop: the power line l_2 — the normally open contact of a contact means PB_{12} of the power switch PB_1 — the normally closed contact of the holder open position detecting switch MC_{11} — the normally open contact of the holder closure position detecting switch MC_{21}.

The detecting switches MC_{11} and MC_{21}, as is shown in FIG. **2,** are arranged to confront cam disks K_1 and K_2 coupled to the output shaft **23***a* of the holder motor M_1, respectively, so that the armature of the switch MC_{11} is maintained connected to the normally closed contact, but is thrown to the normally open contact only when the holder **17** reaches the open position to cause a projection of the cam disk K_1 to actuate the switch MC_{11}, and so that the armature of the switch MC_{21} is maintained connected to the normally open contact, but is thrown to the normally closed contact only when the holder **17** reaches the closure position to cause a recess of the cam disk K_2 to actuate the switch MC_{21}.

Accordingly, the motor M_1 is driven through the above-described loop until the holder **17** has reached the open position (or the closure position, and thereafter the motor M_1 is stopped when the switch MC_{11} (or MC_{21}) is operated to open the loop. This stop-condition of the motor is maintained until the projection (or the recess) of the cam disk K_1 (or K_2) is disengaged from the switch MC_{11} (or MC_{21}) by driving the motor M_1 again whereby the loop is formed again.

The output line d_1 of the start circuit **60** is connected between the switches MC_{11} and MC_{21} in order to open the holder **17,** and a normally open contact means RL_{11} of the relay RL_1 of the start circuit **60** is connected in parallel to the switch MC_{11} in order to close the holder **17.**

It is assumed that, with respect to the holder motor driving circuit **50,** the holder **17** is at the closure position as is shown in FIG. **2,** whereby the armatures of the switches MC_{11} and MC_{21} are on the normally closed contacts NC and the machine is stopped.

Under this condition, if the armature of the power switch PB_{12} is thrown to the normally open contact NO, the power switch PB_{12} will be connected to the output line d_1 of the start circuit **60** through the normally closed contact of the switch MC_{11}, that is, the output line d_1 will be connected to the power line 1_1 through a loop: the contact means RL_{12} of the relay RL_1 — the contact means RL_{51} of the relay RL_5 — the contact means RL_{41} of the relay RL_4. As a result, the motor M_1 is driven, and soon thereafter the switch MC_{21} is disengaged from the recess of the cam disk K_2, that is, the armature of the switch MC_{21} is thrown to the normally open contact NO, whereby a loop of the switch MC_{11} — the switch MC_{21} is formed, so that the operation of the motor M_1 is continued. Thus, the holder **17** continues to move from the closure position until the holder **17** reaches the open position to throw the armature of the switch MC_{11} to the contact NO.

If, when the holder **17** is at the open position, the relay RL_1 of the start circuit **60** is energized, the contact means RL_{11} is closed and the switch MC_{11} is bypassed, whereby the motor is driven. Soon, the projection of the cam disk K_1 is disengaged from the switch MC_{11} whereby the loop of the switch MC_{11} — the switch MC_{21} is formed again. Through the loop thus formed the motor is driven. Thus, the holder **17** continues to move from the open position unitl the holder **17** reaches the closure position to throw the armature of the switch MC_{21} to the contact NC.

If, when the holder is at the closure position, the relay RL_1 is deenergized to throw the armature of the contact means RL_{12} to the contact NC, the holder **17** carries out its opening operation as described above.

In the example, a second holder position detecting switch MC_{22} is connected in parallel to the power switch PB_{11}. If, when the holder **17** is at a position other than the closure position, the power switch PB_{11} is opened, the motor M_1 is energized through the switch MC_{22} until it is opened. Thus, when the operation of the sheet counting mechanism is suspended, the holder **17** is always returned to the closure position.

The vacuum pump driving circuit **52** comprises a vacuum switch VS provided at the output side of the vacuum pump VPM and which acts as a completion detecting means for detecting when counting is completed. When the vacuum produced by the vacuum pump VPM is sufficient for sucking sheets, the armature of the switch VS is thrown to the normally open contact NO so that the count operation relay RL_4 is energized through the normally closed contact means RL_{53} of a relay RL_5. As a result, the armature of the contact means RL_{41} in the start circuit is thrown to the normally open contact NO, and a vacuum pump driving relay RL_3 connected to the output line d_2 of the start circuit **60** is energized. Furthermore, the relay RL_3 is energized through an output line d_3 connected to the normally closed contact NC of the switch MC_{21} in the holder motor driving circuit **50** and through a normally open contact means RL_{13} of the relay RL_1 in the start circuit **60.** When the relay RL_3 is energized, the a normally open contact means RL_{32} of the relay RL_3 is closed and vacuum pump VPM is driven.

If, when the holder **17** is at the closure position, the armature of the switch MC_{21} of the circuit **50** is thrown to the normally closed contact, the relay RL_3 is energized through the contact means RL_{13} of the RL_1 and the vacuum pump VPM is driven. When the vacuum of the vacuum pump VPM is increased and the armature of the vacuum switch VS is thrown to the normally open contact NO, the relay RL_4 is energized. As a result, the armature of the contact means RL_{41} is thrown to the normally open contact NO to energize the relay RL_3. At the same time, the self-maintaining of the relay RL_1 in the start circuit **60** is released to open the contact means RL_{12}.

The rotor driving motor driving circuit **51,** similar to the vacuum pump driving relay RL_3, is connected to the output line d_2 of the start circuit **60,** and to the output line d_3 of the holder motor driving circuit **50** through the contact means RL_{13} of the relay RL_1, and has a series circuit of a normally open contact means RL_{31} of the relay RL_3 and a normally closed contact means RL_{15} of the relay RL_1. Accordingly, the rotor driving motor M_2 is operated by the energization of the relay RL_3.

An output line d_4 connected to the normally open contact NO of the switch MC_{11} in the holder motor driving circuit **50** is connected to a reverse rotation terminal of the rotor driving motor M_2 through a predetermined position detecting switch MC_3 provided in association with the output shaft of the motor M_2. Therefore, when the holder **17** reaches the open position and the armature of the switch MC_{11} is thrown to the normally open contact, the motor M_2 is rotated in the opposite direction until the switch MC_3 is opened, whereby the motor M_2 is stopped at the predetermined position.

The normally closed contact of the vacuum switch VS is connected to a pressure releasing solenoid valve SV provided in the vicinity of a suction port of the suction heads **38** so that, when the switch VS has detected reduction of the vacuum and the armature of the switch VS has been therefore thrown to the normally closed contact, the valve SV is abruptly opened so that sheets are no longer drawn to the suction heads.

In the sheet counting machine according to this invention, the count confirmation output *a* of the count confirmation circuit **56** is applied, as a control input, to the drive control circuit described above.

The count confirmation circuit **56,** as is shown in FIG. **3,** comprises a counter **66** of, for instance, three digits which counts output pulses of a sheet count detector **65.** Data of the counter **66** are displayed on a displayer **67** provided on the control board **58** (FIG. **4**) and are produced as binary-coded decimal outputs.

The sheet count detector **65,** as is shown in FIG. **2,** comprises a proximity switch **69** provided adjacent the peripheral surface of the rotor **37.** Iron pieces **68** are provided on the peripheral surface of the rotor **37** in correspondence to the positions of the suction heads **38** so that the iron pieces pass across the proximity switch **69** during the rotation of the rotor **37.** Accordingly, whenever one iron piece **68** passes across the proximity switch **69,** one count pulse is produced by the proximity switch **69.**

The count pulses thus obtained are introduced to the counter circuit **66** through an input gate circuit **70** which opens when the relay RL_4 (FIG. **5**) is energized. The digit outputs of the counter **66** are applied, as count inputs, to a coincidence detecting circuit **71.**

The counter **66** is reset by a normally open contact means RL_{16} of the start RL_1 when the start relay RL_1 is energized for starting the succeeding count operation. In addition, the counter **66** is also reset by a normally closed contact means RL_{61} of a reset relay RL_6 (FIG. **6**) when the reset switch PB_4 is depressed.

The count confirmation circuit **56** has a device **72** which is adapted to manually set a number of sheets to be counted and to produce a binary-coded decimal output for each of the three-digit number of sheets (hereinafter referred to as "a manual number setting device **72**"). These binary-coded decimal outputs are applied, as set inputs, to the coincidence detecting circuit **71.**

The coincidence detecting circuit **71** operates to compare the digit outputs of the counter **66** with the digit outputs, in the form of the binary-coded decimal outputs, of the manual number setting device **72,** respectively, and upon coincidence, produce a coincidence output at a low voltage level (hereinafter referred to as a logical L level when applicable) for every digit. This coincidence output is applied to a confirmation signal producing circuit **73.**

The confirmation signal producing circuit **73,** as is shown in FIG. **7,** has a diode AND circuit **80** with inverters I. Through the inverters I, the AND circuit **80** receives the coincidence outputs CO_1, CO_2, and CO_3 produced by the coincidence detecting circuit **71** for the respective digits of the number of sheets to be counted, respectively. An output of the diode AND circuit **80** is applied to an output condition circuit **82** through an amplifier circuit **81** composed by cascade-connecting three npn-type transistors Q_1, Q_2 and Q_3.

In the amplifier circuit **81,** the base of the transistor Q_2 is connected to a low level bus line BL through a normally open contact means RL_{103} of an alarm mode relay RL_{10} shown in FIG. **8,** and an output of the diode AND circuit **80** is applied to the base of the transistor Q_3 through an inverter IN_1 and a normally open contact means RL_{104} of the relay RL_{10}.

In the output condition circuit **82,** there are connected in series a switching transistor W controlled by the output of the amplifier circuit **81,** an output relay RL_7, a normally open contact means RL_{82} of an output condition relay RL_8 in a confirmation output condition circuit **83** (FIG. **5**) of the main control section **55,** a normally closed contact means RL_{46} of the count operation relay RL_4, and a normally open contact of a contact means RL_{105} of the alarm mode relay RL_{10}; and the connection point of the contact means RL_{82} and RL_{46} is connected to the normally closed contact of the contact means RL_{105}.

The confirmation output condition relay RL_8 is energized through a series circuit of a contact means R_{45} of the relay RL_4, a normally closed contact means RL_{18} of the start relay RL_1, and a normally closed contact means RL_{62} of the reset relay RL_6 when the vacuum of the vacuum pump VPM reaches the predetermined value and the relay RL_4 is energized, as a result of which the contact means RL_{82} (FIG. **7**) is closed. The energized condition of the relay RL_8 is self-maintained through the normally open contact means Rl_{81}, but is released by opening the contact means RL_{81} when the reset operation is effected or when the relay RL_1 is energized.

The alarm mode relay RL_{10} (FIG. **8**) is energized when an alarm mode switch PB_{3B2} is closed, as a result of which the armature of the contact means RL_{103} is thrown to the normally open contact from the normally closed contact.

The operation of the count confirmation circuit **56** will now be described.

When the alarm mode has been selected, that is, the alarm mode switch PB_{3B2} (FIG. **8**) has been closed, the contact means RL_{103} and RL_{104} of the relay RL_{10} are closed, i.e. thrown to the NO contact thereof, while the armature of the contact means RL_{105} is switched over to the normally open contact (FIG. **7**). Accordingly, the transistor Q_2 in the amplifier circuit **81** is in the off-state, and the collector level output at a high level of the transistor Q_2 is applied to the base of the transistor Q_3.

Under this condition, at least one of the digit outputs of the coincidence detecting circuit **71** is at a high level during a period when the count data of the counter **66** does not coincide with the set data of the manual number setting device **72.** Therefore, the output (at a low level) of the diode AND circuit **80** is applied, as a high level input, to the transistor Q_3 through the inverter IN_1. Accordingly, the transistor Q_3 is caused to be on and its collector level is at a high level which maintains

the switching transistor W of the output condition circuit **82** conductive. If in this case the sheet counting mechanism is operating, the count operation relay RL_4 is in an energized state and its contact means RL_{46} is open. Accordingly, the output relay RL_7 is in a non-energized state.

If the sheet counting mechanism completes the counting of all of the sheets in a stack and the count operation relay RL_4 is therefore deenergized (with the armature of the vacuum switch VS being thrown to the normally closed contact) although no coincidence is detected by the coincidence detecting mechanism yet, the contact means RL_{46} is closed, as a result of which the output relay RL_7 is energized. This will be referred as a first case.

In a second case where the sheet counting operation is completed as soon as the coincidence is detected by the coincidence detecting circuit **71,** all of the digit outputs become low in level. As a result, the output of the inverter IN_1 becomes low in level, and the transistor Q_3 is therefore turned off. Accordingly, the transistor W of the output condition circuit **82** is also made non-conductive, and the output relay RL_7 is not energized.

In a third case where the sheet counting operation is still continued although the coincidence has been detected by the coincidence detecting circuit **71,** when the first detection pulse occurring after the coincidence arrives at the counter **66,** all of the digit outputs of the coincidence detecting circuit **71** become high in level (since the counter **66** is overflowed and all the digits have the FIG. **9**), as a result of which the relay RL_7 is energized upon completion of the sheet counting operation similarly as in the first case described above.

In the case where the alarm mode switch PB_{3B2} (FIG. **8**) is open (not depressed), the contact means RL_{103} and RL_{104} of the relay RL_{10} are open, and the armature of the contact means RL_{105} is on the normally closed contact NO.

When the coincidence has not yet been detected by the coincidence detecting circuit **71,** the output of the diode AND circuit **80** is at a low level, and therefore the transistors Q_1, Q_2 and Q_3 are off, on, and off, respectively. Therefore, the switching transistor W of the output condition circuit **82** is non-conductive, and the relay RL_7 is therefore maintained in a deenergized state. This will be referred to as a first condition.

When after the first condition the coincidence is detected by the coincidence detecting circuit **71,** the output of the diode AND circuit **80** becomes high in level, and therefore the switching transistor W is made conductive, and therefore the relay RL_7 becomes energized. This will be referred to as a second condition.

When after the second condition the sheet counting operation is further continued by the sheet counting mechanism and the coincidence is not detected by the coincidence detecting circuit **71** because of the overflow of the counter **66,** the first condition described above occurs again and the relay RL_7 is deenergized.

When the relay RL_7 is energized, its output actuates a contact means in a stop condition circuit **90** of the main control circuit **55.** The stop condition circuit **90** includes the count confirmation relay RL_5 which is energized through a normally open contact means Rl_{71} of the relay Rl_7 and a normally closed contact means PB_{3A2} of the count switch PB_{3A}. Upon energization of the relay RL_5, the contact means Rl_{51} connected to the output line d_1 of the start circuit **60** is opened.

The count switch PB_{3A2} of the stop condition circuit **90** is also used in common for driving the winker circuit **54** and the sheet separating solenoid driving circuit **53.** More specifically, the winker circuit **54** and the solenoid driving circuit **53** are connected between the power lines l_1 and l_2 through the count switch PB_{3A2} and a cascade connected circuit of an alarm switch PB_{3B3} and an automatic stop switch PB_{3C2} consisting of two contact means. The winker circuit **54** becomes operative by depressing the alarm switch PB_{3B3} only, while the solenoid driving circuit **53** becomes operative by depressing the automatic stop switch PB_{3C2} only. The cascade-connected circuit is a protection circuit which, when the two switches PB_{3B3} and PB_{3C2} are depressed by mistake, prevents the circuits **54** and **53** from becoming operative.

The winker circuit **54** is provided with a contact means RL_{52} of the count confirmation relay RL_5. If, when the alarm switch PB_{3B3} has been depressed, the relay RL_5 is not energized, the armature of the contact means RL_{52} is on the normally closed contact NC, whereby an alarm mode selection display lamp **93** is continuously operated. If the relay RL_5 is energized, the armature of the contact means RL_{52} is thrown to the normally open contact NO, whereby the lamp **93** starts its winking operation.

The solenoid driving circuit **53** is provided with a normally open contact means RL_{72} of the relay RL_7 in the output condition circuit **82** (FIG. **7**). If, when the automatic stop switch PB_{3C2} has been depressed, the relay RL_7 is energized, a solenoid **94** connected to the solenoid driving circuit **53** is energized, and as is shown in FIG. **2,** a sheet separating pawl **96** is operated to separate a stack of sheets **95** from the suction head **38.**

Reference character Z indicated in FIGS. **5, 6** and **7** designates arc-suppression circuits connected in parallel to the respective contact means.

In FIGS. **4** and **5,** reference numeral **98** designates an automatic start condition selection display lamp which is turned on when a normally open contact means PB_{52} of the automatic start switch PB_5 is closed.

When the sheet counting machine thus organized is not operated, the holder **17** (FIGS. **1** and **2**) is at the closed position.

In this condition, first operator determines whether or not the machine should be automatically started by using the automatic start switch PB_5, and selects one count mode by selectively depressing one of the switches in the mode changing switch PB_3.

When the automatic stop mode selecting switch PB_{3C} has been depressed by the operator, he sets a number of sheets to be counted in the automatic stop mode in the manual number setting device **72.** When the alarm mode selection switch PB_{3B} has been depressed by the operator, he sets in the manual number setting device **72** a number of sheets which should be included in a stack (for instance 100, where an official bundle of 1,000-yen bank notes has 100 sheets of 1,000-yen notes). When the count mode selecting switch PB_{3A} has been depressed by the operator, he sets **0** for all the digits in the manual number setting device **72.** Thereafter, he turns on the power switch PB_1.

By turning on the power switch PB_1, the holder motor M_1 is driven through the loop made up of the contact means PB_{12} of the power switch PB_1, the open position detecting switch MC_{11}, the output line d_1, the contact means RL_{12} of the relay RL_1, the contact means Rl_{51} of the relay RL_5, and the contact means RL_{41} of the relay

Rl_4. As a result, the holder **17** is moved to the open position. Now the operator can insert a stack of sheets **95** into the holder **17.**

In the case where the automatic start switch PB_5 has been depressed, the start relay RL_1 is energized immediately when the sheet insertion detecting switch MC_{51} is closed. In the case where the automatic start switch PB_5 has not been depressed by the operator, he depresses the manual start switch PB_2 to close the contact means Pb_{21}, as a result of which the relay Rl_1 is energized.

While the start relay Rl_1 is self-maintained through its contact means Rl_{12}, the motor M_1 is driven again through the loop made up of the power switch PB_{12}, the contact means RL_{11} of the relay RL_1, and the closure position detecting switch MC_{21}. As a result, the holder **17** is closed to hold the stack of sheets **95** between the holder **17** and the pin **30,** that is, the stack of sheets **95** abuts against the suction head **38.**

When the holder **17** is moved to the closed position, the vacuum pump relay RL_3 is energized through the loop made up of the detecting switch MC_{21}, the output line d_3 and the contact means RL_{13} of the relay Rl_1, as a result of which the vacuum pump VPM is operated and the rotor driving motor M_2 starts.

When the output vacuum of the vacuum pump VPM has reached the predetermined value, the vacuum switch VS is operated to energize the count operation relay RL_4. Accordingly, the operations of the vacuum pump VPM and the rotor driving motor M_2 are continued. On the other hend, the air releasing solenoid valve Sv is closed by the operation of the vacuum switch VS, as a result of which the predetermined vacuum is applied to the suction heads **38** to count the number of sheets in the stack **95.**

Furthermore, the energization of the relay RL_4 causes the input gate **70** of the count confirmation circuit **56** (FIG. 3) to open. Through the gate **70** thus opened, count pulses of the detector **65** are applied to the counter **66,** which operates to display a numerical value corresponding to the sheet counting operation of the suction heads **38** on the displayer **67.**

The response operations of the sheet counting machine in completing the sheet counting operation differ according to the sheet counting modes as follows.

First, the case where the automatic stop mode has been selected will be described. In the output circuit **73** of the count confirmation circuit **56,** the contact means RL_{103} and RL_{104} of the alarm mode relay RL_{10} are open, and the armature of the contact means RL_{105} is on the normally closed contact NC. Accordingly, when the contents of the counter **66** coincide with the numerical value set in the manual number setting device **12,** the switching transistor W of the output condition circuit **82** is made conductive. On the other hand, the confirmation output condition relay RL_8 (FIG. **5**) is self-maintained in the energized condition. Therefore, the output relay RL_7 is energized immediately upon the transistor W becoming conductive.

As a result, the sheet separating solenoid **94** is energized through the contact means RL_{72} provided in the solenoid driving circuit **53,** and the sheet separating pawl **96** (FIG. **2**) separates the stack of sheets **95** from the suction head **38.** Accordingly, the suction head **38** sucks the air, pressure vacuum pressure therein is abruptly lowered, and the vacuum switch VS becomes inoperative, thereby detecting the completion of counting of sheets. Therefore, the armature of the switch VS is thrown to the normally closed contact NC, the relay RL_4 is deenergized, and the armature of the contact means Rl_{41} in the start circuit **60** is thrown to the normally closed contact. As a result, the operations of the vacuum pump VPM and the rotor driving motor M_2 are suspended. On the other hand, the count confirmation relay RL_5 in the circuit **90** is energized by the energization of the relay Rl_7. Thus, the sheet counting operation is completed with the holder **17** kept at the closed position.

In the case when all of the sheets in the stack **95** have been counted before the content of the counter **66** coincides with the numerical data set in the manual number setting device **72,** the relay Rl_7 is not energized, and therefore the sheet separating pawl **96** is not operated. However, since there is no sheet on the suction head **38** in this case, the suction head **38** sucks air instead of sheets, as a result of which the vacuum therein is abruptly lowered. Accordingly, the relay RL_4 is deenergized. On the other hand, the count confirmation relay RL_5 is in the deenergized state since the contact means Rl_{71} is open. Therefore, the output line d_1 of the start circuit **60** is connected to the power line l_1 through the loop made up of the contact means RL_{12} of the relay RL_1, the contact means RL_{51} of the relay RL_5, and the contact means RL_{41} of the relay RL_4, so that the holder motor M_1 is driven through the open position detecting switch MC_{11}. As a result, the sheet counting operation is ended with the holder **17** kept at the open position.

Second, the case where the alarm mode has been selected will be described. In this case, the contact means RL_{103} and RL_{104} of the alarm mode relay RL_{10} are closed while the armature of the contact means RL_{105} thereof is on the normally open contact NO in the circuit **73** of the count confirmation circuit **56.** Therefore, the switching transistor W is rendered nonconductive when the contents of the counter **66** coincide with the numerical data set in the manual number setting device **72,** but is rendered conductive when the contents of the counter **66** do not coincide with the numerical data set in the device **72.**

During the period the suction heads **38** are counting the sheets **95,** the relay RL_4 is kept energized to keep the contact means RL_{46} (FIG. 7) open, and therfore the relay RL_7 is not energized.

When the suction heads **38** have counted all of the sheets, there is no sheet on the suction head **38.** Accordingly, the vacuum in the suction head **38** is lowered and the relay RL_4 is deenergized. As a result, similar to the case described above, the operations of the vacuum pump VPM and the rotor driving motor M_2 are suspended. Upon deenergization of the relay RL_4, the contact means RL_{46} is closed, and therefore the output relay RL_7 is energized when the transistor W is conductive (that is, the number of sheets counted is more or less than the set value). Under this condition, the count confirmation relay RL_5 in the circuit **90** is energized and the armature of the contact means RL_{52} in the winker circuit **54** is thrown to the normally open contact, as a result of which the display lamp **93** starts its winking operation. On the other hand, since the contact means RL_{51} of the start circuit **60** is opened by the energization of the relay RL_5, the output line d_1 is not connected to the power line l_1. As a result, the sheet counting operation is ended with the holder **17** kept at the closed position.

On the other hand, when the transistor W is non-conductive (that is, the number of sheets counted is equal to the set value), the output relay RL_7 is not energized and therefore the display lamp **93** of the winker circuit **54** does not carry out the winking operation. In addition, the contact means RL_{51} in the start circuit **60** is closed to connect the output line *d***1** to the power line l_1. As a result, the sheet counting operation is ended with the holder **17** kept at the open position.

In the case where the sheet counting operation in the alarm mode is repeatedly carried out with respect to a plurality of stacks of sheets, the contents of the counter **66** sometimes coincide with the contents set in the manual number setting device **72** during the period time of from the time instant when the start relay RL_1 of the start circuit **60** is energized to the time instant when the previous count contents of the counter **66** is reset. In this case, the winker circuit **54** is sometimes operated. In order to prevent this, the normally open contact means RL_{82} of the confirmation output condition relay RL_8 is provided in the confirmation signal producing circuit **73.**

Thirdly, in the case where the count mode has been selected, the count mode selecting switch PB_{3A2} of the stop condition circuit **90** is open, and therefore the winker circuit and the automatic stop solenoid driving circuit are not operated. When all of the sheets have been counted, no sheet abuts the suction head, that is, the suction head **38** is opened to the atmosphere. Accordingly, the operations of the vacuum pump VPM and the rotor driving motor M_2 are suspended. On the other hand, when the relay RL_4 is deergized, the contact means RL_{51} in the start circuit **60** is closed to connect the output line d_1 to the power line l_1, as a result of which the holder motor M_1 is driven. Thus, the sheet counting operation is completed with the holder **17** kept at the open position.

As is apparent from the above description, according to the invention, in the automatic stop mode the sheet counting operation is automatically suspended with the holder **17** closed when the number of sheets counted coincides with a number of sheets set; and in the alarm mode the winker circuit **54** is operated while the holder **17** is maintained closed when the number of sheets counted does not coincide with a number of sheets set upon completion of the sheet counting operation; and in the count mode all of the sheets are counted without operation of the alarm. Thus, the sheet counting machine according to this invention can positively carry out the sheet counting operation in all of the sheet counting modes.

Furthermore, in the automatic stop mode and also in the alarm mode, the count confirmation output *a* used in common for both of the modes is obtained on the basis of the output of the sheet number setting device operated to set a number of sheets to be counted and the output of the counter. As a result, the sheet counting machine according to the invention is simple in construction and able to positively carry out the sheet separating operation and the count confirming operation with respect to a number of sheets set as desired.

What is claimed is:

1. In a sheet counting machine having a counting means for counting a number of sheets being separated one by one from a stack of sheets held in a sheet holder; a number setting means for setting in advance a number of sheets desired to be counted; a coincidence detecting means to which said counting means and said number setting means are coupled for producing, when a count value obtained by said counting means coincides with the numerical value set in said number setting means, a coincidence detection signal; a completion detecting means for detecting, when the operation of counting all of the sheets in a stack held by said holder has been completed, the completion of said counting operation and producing a completion detection signal; and a control means to which said coincidence detecting means and said completion detecting means are coupled for controlling a sheet counting operation in cooperation with said counting means, said control means:

a. automatic stop mode means for controlling the machine in an automatic stop mode and responsive to the coincidence detection signal produced by said coincidence detecting means for stopping the sheet counting operation of said machine when the count value obtained by said counting means coincides with the numerical value set in said number setting means;

b. alarm mode means for controlling the machine in an alarm mode and including alarm means and means responsive to the coincidence detection signal produced by said coincidence detecting means for inhibiting the stopping of a sheet counting operation through said control means and responsive to the completion detection signal produced by said completion detection means for stopping the sheet counting operation when an operation of counting all of the sheets in a stack held in said holder is completed, and if during this operation no coincidence detection signal is produced by said coincidence detecting means operating said alarm means; and

c. count mode designating means for controlling the machine in a count mode and including means for inhibiting the sheet counting operations effected by operation of said automatic stop mode means and said alarm mode means, and means responsive to the completion detection signal produced by said completion detecting means for stopping, when the counting of all of the sheets in a stack held in said holder is completed, the sheet counting operation,

whereby sheets in a stack held in said holder are counted in a desired mode selected from among said automatic stop mode, alarm mode, and count mode by selective operation of said automatic stop mode means, alarm mode means and count mode designating means.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,983,367

DATED : September 28, 1976

INVENTOR(S) : TAKASHI KONDO et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, left-hand column add:

[30] Foreign application priority data

February 14, 1974 Japan 49-17126

Signed and Sealed this

Twenty-eighth Day of December 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks